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German Steel Foundries

Very interesting information is disclosed in the Report on German Steel Foundries made by Mr. H. P. R. Scott, Mr. S. Leetch and Mr. H. Brewin, all of the Ministry of Supply. Fifteen foundries or their remains were visited and the general impression given is that British steel foundrymen have not much to learn. Obviously no country has a monopoly of brains and in some directions worthwhile advances have been made. Generally speaking, but with some brilliant exceptions, mechanisation has not been so well developed as here, due, no doubt, to the availability of foreign labour. There seems to be a very marked trend towards the increased use of the cement sand moulding process, a system well established in this country but it is largely a question of all or nothing, whilst in Germany, no such exclusiveness was noted. The Germans seem to have lagged behind in modern gating methods and practically all foundries were ensuring soundness through the use of excessively heavy heads as gauged by British standards. As was the case before the war, chamotte—a calcined bauxite clay and ground fireclay, is used for medium and heavy castings. It is interesting, but not necessarily important, to note that the Germans use chamotte stopper ends and nozzles for casting materials other than manganese steel. It is apparently the practice to keep their over size feeding heads liquid by the use of the electric arc—a method not unknown in this country. Several times reference is made to the parting-off of feeding heads by means of large diameter circular saws carrying on their periphery segmental teeth.

An innovation of some import to the steel foundry industry is the production by one foundry at the rate of 300 tons a month of cast steel die blocks ranging in size to maximum of 3 ft. by 3 ft. by 6 ft. This has been done in technical competition with forged steel die blocks and at a reduced price brought about through the reduction in machining costs. Four steels have been developed for this purpose: (1) chrome-nickel-molybdenum; (2) chrome-molybdenum; (3) chrome-molybdenum-vanadium and (4) chrome-vanadium.

A useful hint—though again of strictly limited application—is the casting-on of trunnions in large steel castings to facilitate handling during fettling and processing. They would at least be useful as cast-on test pieces! We feel we should reproduce from the Report the following paragraph:—"*Drying Plates* are of light alloy metal of special design and are placed in boxes before jolt-squeeze action commences, enabling the mould and plate to be rolled over at the same operation ready for the drying stove." We do so as we are not too sure of just how it works, and leave it to the more practical of our readers to visualise the operation. People reading this (No. 109) Report and others emanating from Germany, should mentally regard them as they would similar documents dealing with visits to groups of works situated elsewhere in this country. It can be assumed that the Commissions are well versed in conditions obtaining at home, but they do not and cannot know the internal practice of every concern in this country. Thus, there should be no criticism of alleged novelty because an odd concern in this country is already familiar with the practice. There must also be a realisation of the old adage—"What is one man's meat is another man's poison." Thus a successful process in one area may very well be be a total failure in the next. Read in this light, this particular Report is exceptionally well balanced and distinctly useful.

APPROXIMATELY 32 cwts. of cast iron is required to make an average type American house habitable.

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FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

MARCH 22.

Institute of Vitreous Enamellers :—Quarterly meeting.

Manchester Association of Engineers :—Annual general meeting : " Current Trends in Road Transport Vehicle Design," by D. H. Smith. At the Engineers' Club, Albert Square, Manchester, at 6.45 p.m.

MARCH 23.

Institute of Vitreous Enamellers :—Quarterly meeting.

MARCH 27.

Institute of Welding :—" Plate Edge Preparation for Welding by Oxygen Cutting and Gouging," by E. Seymour Semper and L. J. Hancock. At the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, at 6 p.m.

MARCH 28.

Association for Scientific Photography :—" Towards Atomic Photography," by C. W. Bunn. At Caxton Hall, Westminster, S.W.1.

MARCH 29.

Keighley Association of Engineers :—" The Universe Around Us," by D. W. Dewhirst. At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

APRIL 2.

Institute of Vitreous Enamellers :—" Up-Grading the Vitreous Enamelling Industry," by J. H. Gray. At Charing Cross Hotel, at 6.30 p.m.

APRIL 5.

Institution of Mechanical Engineers :—" The Evolution of a Tank Transmission," by H. E. Merritt. At Storey's Gate, St. James's, Park, London, S.W.1.

APRIL 10.

Institute of Welding (West Scotland branch) :—" Fabrication and Welding of Bridging Equipment," by R. G. Braithwaite. At 39, Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.

APRIL 11.

Institute of Welding (N.E. Tyneside branch) :—" Mild Steel Weld Metal from the Point of View of ' Snow Flakes,' Porosity, etc.," by H. F. Tremlett. At the Mining Institute, Neville Hall, Newcastle-upon-Tyne, at 6.15 p.m.

Staffordshire Iron and Steel Institute :—" Hardness and Hardenability of Steels," by H. A. MacColl. At the Dudley and Staffordshire Technical College, The Broadway, Dudley, at 7 p.m.

APRIL 12.

Institution of Chemical Engineers :—Annual corporate meeting. At the Connaught Rooms, Great Queen Street, London, W.C.2, at 11 a.m.

Institute of Welding (E. Scotland branch) :—Annual general meeting; " Technical Efficiency in the Welding Shop from Design to Inspection of Finished Product," by F. Koenigsberger. At the Heriot Watt College, Chambers Street, Edinburgh, at 7.30 p.m.

Keighley Association of Engineers :—" The Development of British Jet Propulsion," by G. B. R. Feilden. At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

APRIL 24.

Institute of Welding :—" The Evolution of Welded Armoured Fighting Vehicles," by Major R. J. Fowler and Major L. F. Denaro. At the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, at 6 p.m.

Institute of British Foundrymen

MARCH 23.

Bristol and West of England branch :—" The Foundry," by W. McCormick. At the Merchant Venturers' Technical College, Bristol, at 7 p.m.

Lincoln section :—" A Discussion of Problems in Jobbing Ironfoundries," by A. E. McRae Smith. At the Technical College, Lincoln, at 2.45 p.m.

MARCH 25.

Sheffield branch :—" Precision Casting by the Lost Wax Process," by Adam Dunlop. At the Royal Victoria Hotel, Sheffield, at 7 p.m.

MARCH 27.

Birmingham, Coventry and West Midlands branch :—" A Survey on the Mass Production of Small Steel Castings," by W. H. Bamford. At the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7.30 p.m.

London branch :—" The Education and Recruitment of Foundrymen," by Dr. D. H. Ingall. At the Charing Cross Hotel, London, W.C.2, at 7.30 p.m.

MARCH 30.

East Midlands branch :—Annual meeting and short Paper competition. At the Technical College, Derby, at 6 p.m.

Wales and Monmouth branch :—" Production of Tank Wheels in a Mechanised Blackheart Malleable Foundry," by A. B. Bill and J. Peers. At Newport.

NOTES FROM THE BRANCHES

LANCASHIRE.—The annual whist drive, dinner and dance of this branch was held in the Engineers' Club, Manchester, on March 9, Mr. S. H. Brooks presiding. There was a very large attendance.

MR. A. HOPWOOD, the immediate past-president of the Branch, proposed the toast of " The President." He said the branch continued to prosper, mainly due to the fact that the members always cordially and generously supported their President in his efforts to promote its success. They all hoped that their President would long be spared to further the best interests of the branch and of the Institute generally. Mr. Hopwood concluded by mentioning that it was a great pleasure to see so many old friends present.

THE PRESIDENT, in responding to the toast, said that usually anyone in his position was expected to say something about the foundry trade. He did not propose to say very much, however, and he would defy anyone present to say very much about it either. Mr. Hopwood had said that whilst it was delightful to see so many old friends gathered together, it was to be regretted that there were others who had been prevented from attending by illness. He was very pleased to see so many younger members, and when all was said and done it was to the younger generation they must look to in order to ensure the future progress of the industry and its Institute. Mr. A. Phillips and Mr. H. V. Grundy were unable to attend owing to family illness.

The success of the evening was entirely due to the labours of the Social Committee and of the branch Secretary, Mr. H. Buckley, while Mr. G. C. Studley was to be congratulated upon the success with which he had arranged the whist drive.

MR. F. A. HARPER, in a humorous speech, proposed the toast of " The Visitors." Mr. F. Lord, immediate past-President of the Burnley branch, responded to the toast. Dancing continued until 11 p.m., Mr. F. A. Harper officiating as M.C.

WEST RIDING OF YORKSHIRE.—The adjudicators of the S. W. Wise Memorial Prize Competition have recommended that the 1945-46 prize be divided between the Authors of the Papers entitled " Ladle and Furnace Additions of Alloys in the Production of Alloy Cast Iron," and " Is the Pattern Shop an Asset or a Liability? " The successful competitors are respectively, Mr. John Stott and Mr. Herbert Padley, both of Bradford. They presented their Papers at a meeting held recently at the Technical College, Bradford.

AN INTRODUCTION TO METALLURGICAL SPECTROGRAPHIC ANALYSIS*

By D. M. SMITH, B.Sc., D.I.C.

Introduction

The colouring of a bunsen flame when certain metallic salts are introduced into it by means of a platinum wire is well known. If the colour of the flame be analysed by means of a spectroscope, one or more lines of different colour will be seen occupying definite positions. The light given by the flame has thus been separated into the various radiations which compose it, by diffraction through the prism of the spectroscope, each line being an image of the slit on which the light falls. The colours (and consequently the positions) of the lines are different for different elements, but the lines due to one element are characteristic and serve as a means of identifying it. Thus, in 1860, Bunsen discovered the alkali metals rubidium and caesium, and this was followed by the discovery of thallium (Crookes) and indium (Reich and Richter).

In addition to the visible radiations, there are ultra-violet radiations, which are absorbed by glass, but they can be recorded photographically by means of a spectrograph in which all the optical parts are made of glass.

For metallurgical analysis, however, flame spectra are somewhat limited in their application, and the electric arc or condensed spark have proved more useful for this work. There are numerous variations of arc and spark discharges, and the particular type used for any analytical purpose is selected as a result of trial and systematic experiment. Thus, in a general way, an arc is used for the detection of traces of impurities and a spark for the accurate quantitative determination of alloying constituents within the upper and lower limits allowed by specifications.

Each metal gives a distinctive spectrum consisting principally of lines of various intensities. These lines are characteristic in that they do not vary in related position (which is defined in terms of wavelength) in the spectrum of the element. Since most of the useful lines for metallurgical analytical work are in the ultra-violet part of the spectrum, photographic records are generally used.

At first sight it appears a tedious matter to identify all the lines in a spectrum, but, fortunately, this is very rarely necessary. When only small quantities of an element are present as an impurity in a metal, only a few lines due to the impurity appear in the spectrum, and these can be recognised as additional lines by comparing the spectrum with that of the pure metal. These *raies ultimes* or persistent lines have been determined for all the usual elements and tables giving their wavelengths are available.

The early pioneer work in this direction was done by Hartley, Pollok, Leonard and A. de Gramont, one of these being the Dr. Leonard who was unfortunately prevented from being present on this occasion. When some experience has been gained, the distinctive groups of lines given by various commonly occurring impurities will be recognised at a glance.

Qualitative Analysis

The spectrum of an alloy shows lines due to all the metallic constituents, also silicon, phosphorus and boron, and with experience it is possible to judge which are the alloying elements and which are the impurities. The spectrograph is therefore an extremely useful adjunct to a chemical laboratory in giving an approximate indication of the principal constituents and impurities in an alloy of unknown composition. It is often useful in planning the chemical analysis, for example, to know beforehand whether certain elements are present or not.

Semi-quantitative Analysis

As the amount of an element in an alloy increases, the intensity of the lines due to this element also increases. A measure of the relative intensity of these lines is obtained from the blackening they produce on the photographic plate, and this is used to estimate the concentration of the element in question. The concentration is not usually determined directly from the intensity of the line, but the intensity of the impurity line is compared with that of a neighbouring line due to the basis metal (*internal standard method*).

In cases where spectrographic analytical tables are available, the impurities present in an alloy can often be determined with sufficient accuracy by visual examination of the spectra and reference to such tables (compiled previously from the spectra of a range of accurately analysed standards). Methods of this type are rapid, and they often suffice either as a rough check of composition or as a means of ensuring that impurities are below certain limits.

Accurate Analysis with the Microphotometer

The introduction of the microphotometer as a standard instrument for the measurement of line densities has been responsible for the remarkable increase in the accuracy of modern spectrographic analysis. With this instrument the errors due to the personal factor and the uncertainties of purely visual estimation are to a great extent removed. An enlarged image of the spectrum line is focused on a photocell slit by means of a microscope objective, the light from a filament bulb being focused on the line. The photocell is connected to a galvanometer, the scale reading giving a measure of the transmitted light. From this reading the density can be calculated.

* A Paper read before the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen, Mr. J. J. Sheehan presiding.

Spectrographic Analysis

The successful industrial application of the spectrograph in replacing chemical methods for analysis of non-ferrous alloys has so far been mainly confined to the control of production of particular types of alloy, the samples for analysis being in the cast condition. Before analysing any unknown sample, standards covering a range of composition are prepared and a calibration curve is obtained by plotting density differences (log ratios of galvanometer deflections) of selected pairs of lines (*internal standard method*) against logarithm composition of the standards.

For non-ferrous alloys it has generally been found necessary to photograph spectra of both standard alloys and samples for analysis on each plate, although for steel analysis this does not appear to be necessary once the calibration curve has been determined for a particular set of working conditions and a particular batch of plates.

Effects of Alloying Constituents and Metallurgical History

It is generally agreed that the standard alloys used for the analysis of aluminium alloys should be closely similar, both as regards bulk composition and metallurgical history, to the samples for analysis. For this reason spectrographic methods for the analysis of samples of unknown metallurgical history cannot be regarded as reliable and are less extensively used. The re-casting of wrought materials for comparison is sometimes recommended; if this process be adopted the possibility of loss by volatilisation of certain elements, notably zinc and magnesium, should be kept in mind.

Preparation of Electrodes

The electrodes are usually chill cast in the form of pencils 6 to 10 mm. dia. and 8 to 15 mm. in length, and the sparking ends are machined to a standard shape. The optimum conditions for casting vary for different types of alloy. The essential feature of the casting process is the production of a sample having a uniform fine-grain microstructure, free from porosity and from segregation of any of the constituents. It is important that the standard alloys and samples for analysis be prepared in exactly the same manner, and the pouring temperature and temperature of the die must therefore be controlled.

Analytical Accuracy

Since the average error of any spectrographic method is usually a percentage of the absolute amount to be determined, high percentages, *e.g.*, over 2.5 per cent., are generally more accurately estimated chemically. Spectrographic methods should be regarded as supplementing, but not entirely replacing chemical analysis. They are most useful for those determinations which are long and tedious when carried out by ordinary chemical methods.

The reproducibility of spectrographic methods is usually determined statistically from the results of some 50 analyses on the same sample. A standard deviation of $\pm$ 5 per cent. of the amount present may be regarded as satisfactory, although lower errors have been reported. The spectrographic method is more automatic than the average chemical method, which allows greater opportunities for accidental errors on the part of the operator.

Improving the Accuracy of Spectrographic Analysis

The British Non-Ferrous Metals Research Association has for some time been collaborating with its members in attempting to improve the accuracy of spectrographic methods. Four panels of the Research Sub-committee dealing with this subject have been formed. The photographic panel has had the advice of the photographic experts in drawing up a recommended method for processing the plates to secure uniformity in development. The aluminium and lead panels have recommended methods for the analysis of alloys of these metals, and a further panel is concerned with the study of the basic problems common to all the methods.

One of the most important basic problems arises from the fact that while each spectrographic laboratory can standardise a satisfactory technique for its own use, it does not follow that a method used in one laboratory will give the same results in another. This is an important point which has been brought to light as a result of the co-operative work of the aluminium panel. While methods for the analytical control of production of aluminium alloys are now well established, there is some divergence of opinion as to the best technique to be used. Recent work has indicated that the main sources of error and disagreement arise from differences in superficially similar sparking circuits which give rise to variations in the spark itself. Attempts are now being made to determine the characteristics of the spark, and it is hoped that it will ultimately be possible to specify a spark circuit which can be relied upon to give identical and reproducible results.

The above comments have dealt with the analysis of non-ferrous metals and alloys, a branch of the subject with which the Author is more familiar. F. G. Barker, of the Bragg Laboratory, Admiralty Inspection Department, Sheffield, has demonstrated the possibility of making quantitative determinations of several elements in alloy steels with an accuracy approaching that obtainable by chemical analysis. (*J. Iron & Steel Institute*, 1939, **139**, 211-225.) With a modification of the technique the method has been applied to the analysis of segregates (F. G. Barker, J. Convey and J. H. Oldfield, *Ibid.*, 1941, **144**, 183-201), and more recent work has shown how variations in composition across a segregate may be traced by means of the traversing micro-spark (*J. & Proc. Inst. Chem.*, August, 1943, (4), 138-140).

It has been said that spectrographic analysis is still more of an art than a science. On the other hand, there is already a vast accumulation of data available to guide those who are about to adopt this method. Specialists are now beginning to understand the problems, and this is the first step to solving them.

Vote of Thanks

MR. J. G. PEARCE (Director, British Cast Iron Research Association), in proposing a vote of thanks to Mr. Smith, described the lecturer as one of the outstanding specialists on the subject in this country, and said he was pioneering a method which he (Mr. Pearce) thought was going a very long way in the future. So far as steels were concerned, a great deal of work had been done at the Bragg Laboratory at Sheffield, but in the case of cast iron the amount of work done so far had been extremely small. They had not felt quite the same need for the method as the non-ferrous interests and the steel people, because the small traces of elements had not assumed with them the same importance. Further, there were some elements which were more important to them, but which were very difficult to deal with by spectrographic methods. In the B.C.I.R.A. they were becoming equipped for the application of the spectrographic method, and he thought that pointed the way things were bound to go. Just how far it would become a routine method for works remained to be seen. He added that he believed most of the spectrographic apparatus made in this country was exported.

MR. H. G. HALL, who seconded the proposition, said Mr. Smith had given them a vision of the future which for the chemist was rather dismaying. For the big works' laboratories there were obvious possibilities. From the cast iron point of view, provided they received a uniform and homogeneous sample, it should be possible to achieve remarkably quick and accurate results regarding some elements.

The vote of thanks was heartily accorded.

Discussion

MR. A. ARGYLE asked the lecturer what exactly was the action of the arc or spark on the sample. Did the sample fuse, or volatilise without fusion? Why was the arc more sensitive than the spark in detecting traces of impurities?

MR. SMITH replied that the action of the arc or spark was a most complicated affair, and he would not like to say what actually happened. In the arc there was a lower form of excitation, and the whole of the energy went into the lines of low excitation potential. In the case of the spark, true "spark" lines as well as the arc lines, the energy being split up between the ionised lines and the arc lines. Therefore in arc spectra it was to be expected that the persistent lines would be more strongly excited, whereas in the spark there was not so much energy available for the arc lines and they were not so well developed. But there were curious anomalies. Spectrographic analysis was still empirical.

The Case of Cast Iron

DR. R. V. RILEY said his firm had recently decided to instal a spectrograph for the analysis of refined pig-iron. In commencing this work they had been surprised at the lack of detailed information which was available in the Press, both of this country and America. In American literature great stress was laid on speed rather than accuracy of analysis. In a number of circuits he noticed that an air blast was used across the spark gaps. He was not quite clear as to what the function of that was. The Americans also seemed to be using higher and higher voltages for the a.c. spark excitation circuit. The present voltage recommended for British work was 15,000, but the Americans were apparently going up to 40,000. What was the advantage of the higher voltage? As to gap width, he realised that this had a bearing on the analysis from the point of view of whether they were going to get a representative analysis, or an analysis of the particular aggregate in the neighbourhood. In cast iron, particularly, they were interested in getting a representative analysis, rather than an analysis of the material immediately below the electrode. He wondered whether it was desirable to have a narrow gap width, or a wide gap width to secure this result. There was also the question, which was never fully answered, namely, the size and shape of specimens. There appeared to be a school of thought, especially in the non-ferrous world, which favoured the pencil type of specimen. These were particularly difficult to make in cast iron. Supposing one made an ordinary block of cast iron, either sand cast or chill cast, would the effect be the same in the spectrograph? He would also like to know whether one could use a calibration curve for any particular shape or size coming into the works for investigation. Finally, what did the lecturer think of the analysis of cast iron in general by the spectrograph? Would it be a much more difficult job than in the case of non-ferrous metals.

Air Blast

Referring to air blast, MR. SMITH said the usual function of air blast was to dissipate the accumulation of ions which had formed in the gap and which lowered the potential. If they had an element which required a high voltage or excitation to produce the necessary line, as the spark proceeded it would become weaker and weaker. With regard to the Americans using higher voltages, and incidentally higher power sets, than in England, that was a question that had worried them for some time. The Americans apparently used them because they had them available. The transformers in this country often varied from one laboratory to another, sometimes even if they were rated to the same specification. His colleague, Mr. Walsh, found that the design of the transformers used in this country was rather critical, and at the present time it appeared to be necessary to specify the shape and length of leads and almost every other part of the spark circuit. He was not, therefore, in a position to say yet whether or not it was advantageous to use higher voltage or power. At the moment he felt that the excitation of the spark was a question requiring much more study before they could lay down what was necessary to give the best results. Each alloy apparently required a different circuit. The Dietert multi-source unit seemed to be a step in the right direction, in that it was capable of giving a wide range of types of excitation, and was worth a trial in this country. Gap width affected the results considerably. At the moment he did not think there

Spectrographic Analysis

was much scope for the quantitative analysis of odd pieces coming to an inspection laboratory.

He had had no experience of cast iron, but he imagined that when they started investigating it there would be plenty of problems to solve. Nevertheless, with diligence and perseverance there was no reason why they should not arrive at methods which would give them the accuracy they wanted. He thought that all the points that were important in non-ferrous analysis would also be important in the case of cast iron. It would be important to determine at the start whether the shape of sample—whether it was a pencil or a slab—modified the spectrum. It would be an advantage to cast different types and compare them.

In reply to further questions, Mr. Smith said he had had no personal experience of mains voltage control, but it seemed reasonable to suppose that if there were violent fluctuations in the supply it would automatically affect the output, and that some form of stabilisation was desirable. As to the function of inductance, in the past it had been customary to use this for the suppression of air lines, as most workers liked to obtain a "clean" spectrum and to avoid masking of lines, particularly when a small size spectrograph was used. What mattered most, however, was the slope of the calibration curve. Another function of inductance related to the standardisation of the spark circuit. He thought that people in this country had followed the German workers, who had, on theoretical grounds, advised that in standardising electrical conditions, certain arc and spark lines should be brought to equal intensity by systematic variation of capacity and inductance in the circuit. One liked to have the air lines out, but if they did not cause trouble he advised them to leave them in. With reference to the estimation of silicon in cast iron and as to whether the state of the silicon would affect the results, he thought it would. Wherever they got the formation of intermetallic compounds they were likely to get a change in the volatilisation of the material and thus a change in excitation conditions.

Coloured Reproduction

MR. J. G. S. PRIMROSE said the lecturer had shown them a lot of interesting pictures, but they were in black and white. The spectrum, however, consisted of colours, and he suggested that it would be an advantage if they could get a coloured reproduction. Cast iron was much more comparable with the work done by the steel people. They found that instead of graphite it was preferable to use pure iron wire electrodes.

Answering Mr. Primrose's first point, MR. SMITH pointed out that they were assured by the photographic plate manufacturers that the response of the photographic plate to ultra-violet light was far more uniform than to visible light. He thought the work done in light alloy analysis and steel would continue to be done in the ultra-violet part of the spectrum as they knew very much more about it, while the photographic people could cope with the emulsion side of the matter. As to the shape of electrodes, in the first work they did on zinc, they used wedge-shaped electrodes with the idea of controlling the wandering of the spark discharge and of keeping it in line with the axis of the spectrograph. They found, however, that the sparks now in use were reasonably regular and that when focused within the optical system of the spectrograph, uniform results were obtained.

The CHAIRMAN (Mr. J. J. S. Sheehan) asked whether the methods described would be likely to ease the foundryman's burden by finding trace elements in malleable iron, which interfered very much with the annealing cycles. Was spectrographic analysis capable of correlating the effects in castings with the trace elements that would be indicated.

MR. SMITH replied that so long as the impurities were metallic there was a very good chance that it would be possible to detect these small quantities and correlate them in some way with the behaviour of the material.

NEW MOTOR-CAR INDUSTRY FOR GLASGOW ENVISAGED

Mr. W. D. Kendall, M.P., the light-car manufacturer, in a recent interview with our Scottish correspondent, confirmed that he was willing to take over part of the Rolls Royce factories at Hillington, Glasgow, for the manufacture of 7-h.p. cars, costing £150, and tractors. He said he would like, in the event of the negotiations being successful, to employ the 8,000 men who would be available when the Rolls Royce company gave up the factory. The eventual employment of 15,000 to 20,000 workers is envisaged.

If hopes are realised, Mr. Kendall will take over two and a half blocks of the factory for the manufacture of his light car and light medium tractor. Mr. Kendall has already a direct interest in the resources of the Hillington factories, as some of the light castings for his car are being made in the foundry at Hillington. This association is regarded as providing a promising basis for an extension of an enterprise which would satisfy the desire that Scotland should not again "miss the boat" in sharing in the motor-car industry.

AT THE ANNUAL GENERAL MEETING of the Council of Ironfoundry Associations, held on March 14, the following officers were elected:—Mr. FitzHerbert Wright, Chairman; Mr. J. D. Carmichael, Mr. W. R. Blair, and Major F. D. Ley, vice-Chairmen; and Mr. T. E. Parkinson, Secretary.

Mr. P. L. Gould was re-elected to fill the vacancy on the Executive Committee and the following members were also co-opted to that Committee:—Mr. S. H. Russell, Mr. A. E. Pearce, Mr. T. McKenna, Dr. J. E. Hurst and Mr. J. Gardom. Peat Marwick & Mitchell, Limited, were re-elected as honorary auditors.

SHORTAGE OF MOULDERS in the light-castings industry is jeopardising Scotland's housing drive. So serious has it become—although improvement is showing—that one firm in the Falkirk area is prepared to set 200 moulders to work—if they were available.

SOME PATTERN SHOP METHODS AND THEIR ADVANTAGES TO THE FOUNDRY*

By H. W. TURNER

In this short Paper the Author does not attempt to present anything startling in the way of new methods, and it may appear to those who are familiar with pattern shop practice that some of the points touched upon are of a somewhat elementary nature. The job which presents special problems or difficulties is the one which demands from the pattern-maker those subtle variations of method which are so essentially a part of his trade. In order, however, to maintain a steady and satisfactory standard of pattern-making, it is the intelligent application of sound principles proven in practice which must form the working basis day-by-day.

Many interesting papers are written on subjects vital to the foundry, but it is seldom that one is found which deals with pattern-making in a more than fleeting manner. This rather suggests that satisfactory pattern equipment is too often taken for granted. If satisfactory patterns were easily acquired this would no doubt be justified, but the truth is, of course, that here, at the beginning, and often before a tool has touched the timber, the success or failure of a job may be decided. Good castings cannot be expected from patterns produced in a shoddy manner or with little thought given to the methods employed.

Principal Aim of Pattern Shop

The principal aim of the pattern shop should be to supply to the foundry, pattern equipment which is accurate dimensionally, strong enough in construction to complete the order, and suitable in method to enable the castings to be produced at an economic price. Equally important is the service and maintenance of equipment during the period of its use.

It is usual and very natural for more consideration to be given to material soundness than to dimensional accuracy when casting problems are being discussed by foundry technicians, especially in these days of laboratory control, but there are so many ways in which an intrinsically sound casting can be scrapped that equal importance should be attached to the methods by which accuracy is sought. Casting soundness may, to a considerable extent, be bound up with sound methods of pattern making. If good results are to be obtained in the casting, it is desirable that the pattern equipment should be planned and made in accordance with the foundry's requirements, and that is best achieved if the foundry has its own pattern shop adequately equipped to deal with any class of work. For a variety of reasons, however, the foundry must often use equipment supplied by its customers, often without previous consultation regarding its suitability, and this may be the cause of many "headaches" and much delay. Apart from the question of accuracy, there is the possibility that castings will be produced in an uneconomic manner from equipment which will not stand the numbers required. It is, therefore, of the utmost importance that when patterns are not made "on the spot" there should be the closest *liaison* between foundry and supplying pattern shop, so that the castings may be produced by the most straightforward and practical method peculiar to that particular foundry. The accuracy of pattern equipment is of primary importance, but it is a fact that a pattern made with absolute accuracy can be the source of much trouble.

Core Tolerances

Sand is not the easiest of media with which to work, and however capable the moulder may be, he cannot be expected to work without some dimensional latitude. It is part of the pattern-maker's job then to allow such tolerances as are reasonable to the size of the job, in order to ensure that the cores may be set to maintain thicknesses and to enable the casting to hold the lines when being marked off during inspection. This is particularly important in all cases where strength is a main factor, for it is often the case that here a scantiness of metal means a scrap casting.

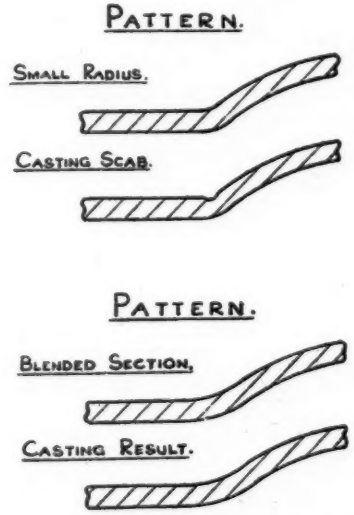

FIG. 1.—ELIMINATION OF SCABBING BY INCREASED RADIUS.

*A Paper read before the Slough section of the London branch of the Institute of British Foundrymen, Mr. A. Logan presiding. The Author is pattern shop foreman, High Duty Alloys, Limited.

Some Pattern Shop Methods

Where a number of cores have to be set, some degree of tolerance must be allowed, and though in many cases casting limits are indicated on the drawing, it is often very difficult where many customers are to be considered, to decide just what these tolerances should be. The ideas of one customer on what constitutes a satisfactory casting dimensionally, often contrast sharply with another whose chief consideration, especially where light alloys are concerned, may be the saving of weight, with strength a secondary consideration. It will be seen then that it is impossible to generalise in the matter of tolerance; each job must be studied individually.

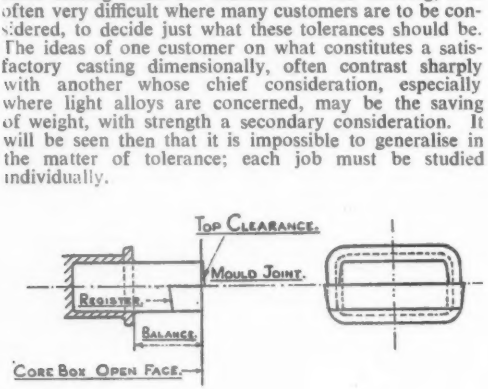

FIG. 2.—A SYSTEM OF COREPRINTS FOR ACCURATE LOCATION.

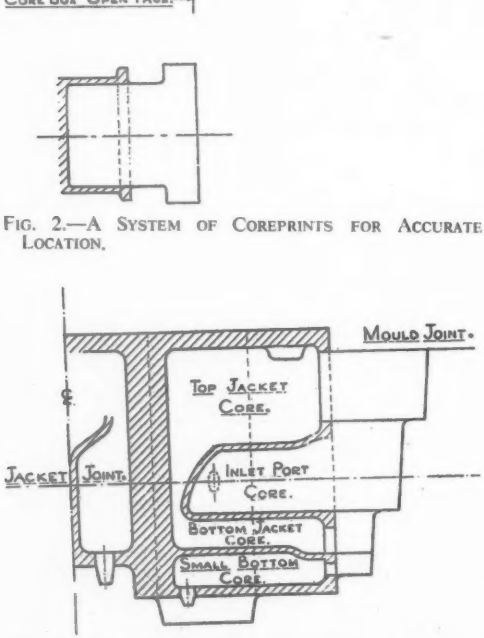

FIG. 3.—CORE-SETTING ARRANGEMENT FOR THE NAPIER "SABRE" CYLINDER BLOCK.

Use of Jigs

Where close limits are essential, the use of jigs, both in the core shop and during the coring-up, is very desirable. These are often made in the pattern shop and should be as simple as possible in construction and capable of easy and direct application.

Jigs or gauges are not normally made for small-quantity jobs, but are provided at the request of the foundry or core shop if difficulties are encountered. Experience has shown that it is wise to provide core-jigs and gauges as part of the pattern equipment on some types of work, such as oil-sand jacket cores. There is often a tendency for such cores to sag or distort, and it is usual to leave a plus allowance of approximately $\frac{1}{16}$ in. on the joints of the cores and to provide a jig and gauges which will check the core for distortion and at the same time enable the joint to be correctly adjusted. The construction of such jigs is largely dependent upon the number of castings required.

Coring-up jigs are best located from the moulding-box pin centres, although this is only possible when the pattern is plated or on boards and is itself located in the moulding box. The use of cores is, of course, necessary in many types of work, but a saving in cost and greater accuracy may often be obtained by the use of matching boards, which carry the internal shapes in the form of green-sand cods and on which the moulding boxes are registered by the pin centres.

Sharp Corners

The pattern-maker should be aware that sharp corners, either internal or external, are undesirable and may increase the liability to shrinks and tears, resulting in a weakening of the casting. There is a tendency, especially with the light alloys, to draw into the internal corners during the process of contraction and solidification, with the results that a $\frac{1}{4}$-in. radius fillet is sometimes reduced to $\frac{3}{16}$-in. radius. It is good practice to leave a larger radius on the pattern or corebox than is called for on the drawing.

On horizontal surfaces a change in the angle of flow sometimes encourages scabbing, and this can largely be obviated if the pattern-maker joins the two angles with a large radius with no sudden break to interrupt the smooth flow of the metal. Fig. 1 illustrates a pattern modification to reduce scabbing or buckling tendencies.

Bosses and Core Prints

Bosses, too, are always worthy of consideration, and in some cases can constitute a major problem in the foundry. The tendency to fractures where a large boss joins a comparatively thin wall section can frequently be overcome by a generous fillet at this point. If cores are to be set accurately, it is obvious that special attention should be given to the core prints which anchor them in position. Vital points to remember when core location is being considered are: adequate balance, secure seating, not forgetting the possibility of some of the registering area being cut away by the runner and riser system, and a top clearance to ensure a safe close-over where the core is standing

above the joint. Fig. 2 shows a method of accurate and firm core location with provision for a safe close-over.

It is often the case that when a series of cores are to be set, the pattern has been made in such a manner that some cores are dependent on others for their setting. In the Author's opinion this should be avoided whenever possible. Small inaccuracies on a succession of cores may accumulate and cause a scrap casting. More often than not, it is possible to devise a method of giving each core a fair setting in the mould itself, and this reduces the ratio of error according to the number of cores to be set.

If the design of the job be such that cores must be registered in each other, then suitable gauges should be made and used at the core-checking stage to ensure that the chances of error in coring-up are reduced to a minimum. Fig. 3 shows an example of individual core-setting which proved satisfactory. It is the Napier "Sabre" cylinder block. The bottom jacket cores, inlet port cores and top jacket cores project on each side of the casting in that order. Individual setting is given to each by forming the prints in steps. This has the advantage of allowing the moulder to see whether the tops of the first line of cores are matching the next step and ensuring that the successive banks of cores are each being set on a definite line. Methods such as these should be standard practice on production work; indeed, on all work except where the number off is low and the extra cost would not be balanced by the saving effected in the foundry. It should, however, be emphasised that where these practices become familiar as part of a routine, there is very little difference in time taken to produce equipment with these advantages and that on which they have been neglected.

Contraction

With regard to contraction, all pattern-makers use their contraction rules which are designed to cover the shrinkage of the various metals; but there are factors affecting contraction which make it necessary at times to depart from hard and fast rules. It has been found by observation over a period and by experience on particular jobs that castings of various designs in the same material will show a very distinct difference in contraction. This may be accounted for in most cases by the shape of the casting or the nature of the mould and coring. Perhaps the most common example is where a casting is "held out" by a heavy and hard core which is almost totally enclosed.

It is obvious that a flat or dish-shaped cover, for instance, will have unrestricted contraction, and that a box-shaped job with a green-sand cod will have a better chance of contracting normally than a job of similar shape carrying an oil-sand core.

It is necessary, therefore, to consider the design of a casting from the drawing and by taking into consideration the proposed method of moulding, and also the probable position and weight of runners, risers, etc., determine to some degree whether or not a variation in contraction will result. The Author would hesitate to say to what extent a definite dimensional assessment can be made, but it can be said that contractional variation either way may be foreseen in many cases,

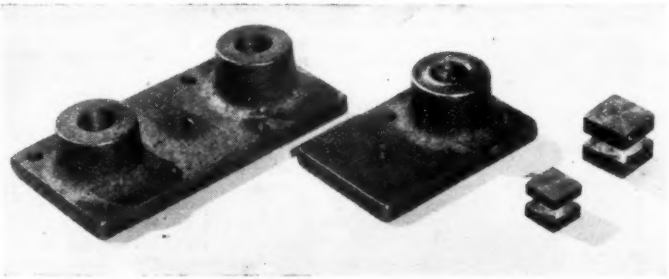

FIG. 4.—BUSHED PLATES DESIGNED BY THE AUTHOR FOR RAPPING PLATES.

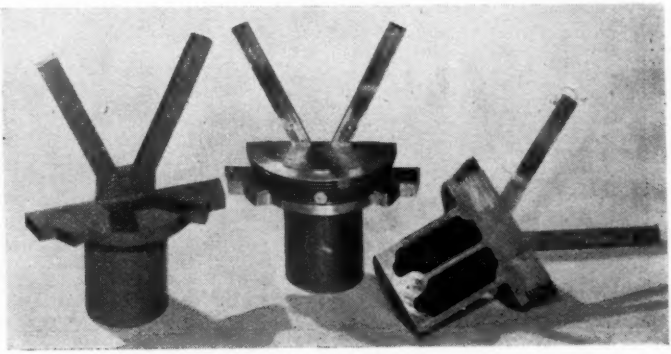

FIG. 5.—SHOWS THE MASTER PATTERN FOR THE MAIN CASTING.

Some Pattern Shop Methods

and the pattern-maker, by intelligent application of this knowledge, may make adjustments on the pattern equipment which will bring the casting within the finer limits than would be possible if he adhered strictly to his ordinary contraction rule.

Metal Pattern Equipment

The materials from which patterns are made are determined largely by the number off, the size of the job, the moulding method to be employed, and so on. These observations are confined to wood and metal. Broadly speaking, metal pattern equipment is used when large quantities of castings are required, or for smaller quantities when wood is considered too frail. A metal pattern will retain its accuracy and last much longer than its wooden counterpart; also it will be far less liable to wear or damage. There are, however, many considerations involved when deciding material and the only safe course is to study each job individually and decide according to its own peculiarities. Probably one of the most important things to consider when making any pattern is the construction, for on this depends the life of the pattern and also its retention of accuracy.

Rapping Plates

The construction of wooden equipment must involve the consideration of several cardinal points. First, how many castings are required. If the number be small, obviously the construction will be as simple as possible. As the number increases, so the construction will be elaborated to eliminate shrinkage and to strengthen the pattern. Pattern strength is especially important where heavy floor jobs are concerned, and it has been found that the usual type of rapping plate is inadequate on this kind of pattern. The use of specially bushed plates has been found to be advantageous (Fig. 4).

Air-cooled Cylinder Heads

The Author was recently responsible for the production of metal pattern equipment which illustrates the value of construction by a method which was determined after a study of the component drawing, as being strong and tending to maintain accuracy. This is for an air-cooled cylinder head. The fins, which are deep and of fine pitch, vary directionally in series. It was first decided that the pattern would be used on the Sandslinger, and that it should be made in brass and bronze, in order to withstand the abrasive action of the sand during the slinging operation; also it is generally agreed that brass gives a cleaner "leave" on this type of job.

A close study of the various features of design is necessary at this stage as a clear perception of each form and section, and their significance, when considered as a whole, is essential when deciding where moulding joints shall be located, which areas shall be in core and which in mould, and also the order in which cores shall be inserted, and whether they will be free to pass into the mould without obstruction from the mould itself or from cores already set.

"Lay-outs"

The next stage is the making of suitable "lay-outs." These are invaluable and must be accurate, as they are constantly referred to throughout the making of both the job and the gauges, and constitute to the pattern shop the main source of reference during the run of production. Each elevation and section considered essential are scribed on a sheet of suitable material, in this case sheet aluminium, and are laid out to contraction size. The core locations are added and joint lines indicated. At this point the question

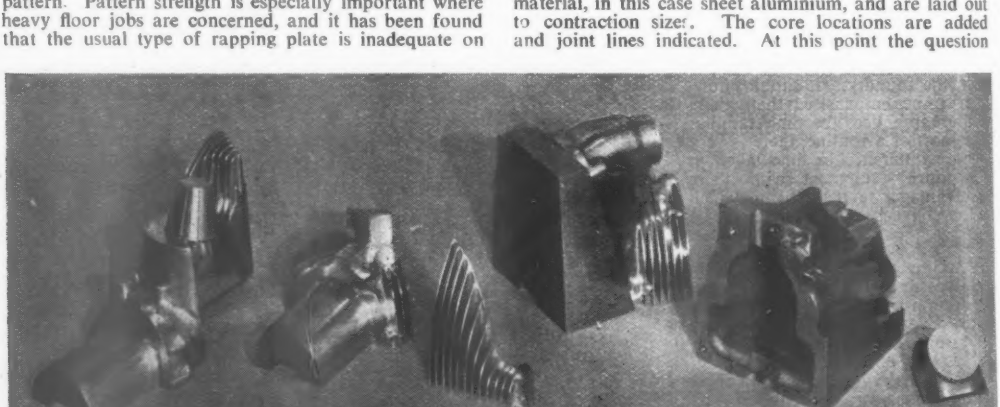

FIG. 6.—PATTERN SECTIONS FOR THE "SABRE" CYLINDER BLOCK.

of actual construction methods are considered and, having been decided upon, the main construction lines may be added to the lay-out.

In this case two separate lay-outs were made, one being chiefly to indicate fine positioning and outside profile, and the other representing the main body shapes and rocker boxes, etc.

It will be seen that the main centres of the head are in the form of a "V," so it was decided that the basis of each half-pattern should be a brass casting incorporating the main core-print, the main flange and two arms conforming to the main centres. Fig. 5 shows the master pattern for the main castings and the main castings with the first series of body fins assembled. These were machined and dowelled together accurately and form the basis of construction.

Those parts of the head which are free of fins or which carry very little finning have also been made in casting form, and it will be noted that slots have been machined through the bottom of these castings to fit over the base casting (Fig. 6). This ensures main centre acuracy. The body shape is entirely covered with fins and the pitch of these varies at several sections. The whole of this part of the head is built up of single fins, parted at the appropriate pitch and carrying a section of the body shape at the root of each.

Special attention was paid to those sections of fin which ran in diverse directions and form a junction with the first fin in another section. These were brought through to form the first fin of the next section; this ensures that all are held firmly in position. The straight fins are of sheet brass and those in the form of an open "V" are produced from blank bronze castings (Fig. 7). In order to ensure that the body shape was accurately achieved at each section of fin, a wooden model of the body shape was made. This was built up to similar sections as those of the brass fins, each

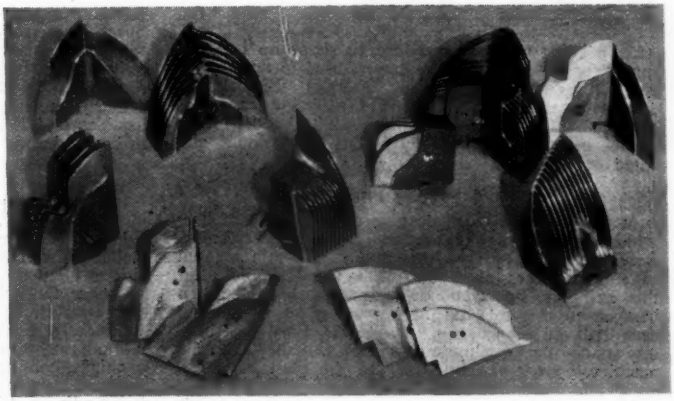

FIG. 7.—SHOWING METHOD OF FIN CONSTRUCTION.

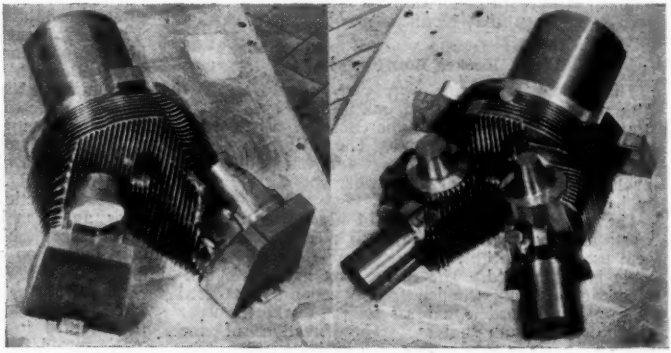

FIG. 8.—HALF PATTERNS MOULDED ON PLATES.

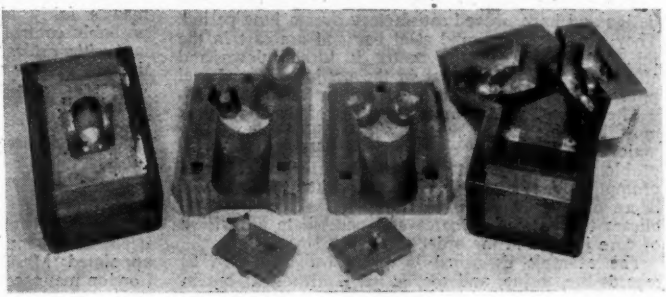

FIG. 9.—SHOWING CORE BOX CONSTRUCTION.

Some Pattern Shop Methods

section being used to reproduce its shape on its brass counterpart. Silver-steel rods were used to dowel each set of fins together, and by inserting these dowels square to the angle of the fins a locking effect is obtained. The assembly of the body is also dependent on the main casting, each set of fins being slotted and fitted over the "V" bars.

Mould Sagging Problems

Mention should be made here of an important item which was taken into account from the beginning. Previous experience has shown that a certain amount of sagging takes place on the oil-sand mould after the stripping operation on this type of job. To compensate for this, a plus allowance of 1 mm. on each half of the pattern was made. Final assembly was made on an aluminium plate for use with the machine boxes. Each corner of the plate carries a register for setting the two mould blocks (Fig. 8).

The wooden master patterns were a considerable job in themselves and there is no doubt that extra time spent at this stage in making neat and accurate master patterns is well spent, for nothing is worse than to find at a later stage that rectification of pattern castings must be made.

Rocker Box Forms

The rocker box forms were cast near to size and with as few fins as possible, machining being left on straightforward faces only. The contours were finished by hand, as were the cast fins. The main casting was machined practically all over and the fins were machined as far as was practicable and then finished by hand.

The core boxes (Fig. 9) are of aluminium and the construction was kept as simple as possible. Castings were used and machined where possible, internal forms being hand finished. The rocker box halves are contained in a strong wooden frame, generously tapered all round and lined with brass strips to take the wear of the aluminium halves. The function of the wooden frames is to maintain a close joint and to take any rapping which is necessary. It is possible to replace them at short notice.

The dowels (Fig. 4) used are of the Author's own design and have proved satisfactory over a long period. They are of square mild steel bar and are cast in the job. A section in the centre is turned down and effectively locks the dowel in the casting. The dowel pin is of silver steel and is a drive fit into the male half.

These, then, are the main essentials of the job, but it must be remembered that in the working out of any major job, a number of smaller details may arise as problems which must be settled satisfactorily and promptly. A small angle, pipe or pocket, hidden away in an obscure corner of the drawing may easily complicate the passing of cores and necessitate a revision of core joints and the order of setting.

The example described is quite straightforward as regards the coring, and the design is orthodox; but in many instances casting design is so complicated that it would appear that no consideration has been given by the designer to problems of manufacture. Then the pattern-maker is called upon to exercise his ingenuity to the fullest extent. Keen perception and skill must be brought to bear upon these problems if the foundry is to be reasonably free from moulding troubles and if dimensionally satisfactory castings are to be produced.

GERMAN DIE-CASTING PLANTS

Mr. J. J. Lowe and Mr. A. T. Lillegren, both of the United States Ordnance Department, reporting on their visit to German die-casting plants to the Combined Intelligence Objectives Sub-committee, have summarised their conclusions in the following statement:—

General Observations.—The findings of the investigators have proved that the German die-casting industry is chiefly confined to two areas, namely, Berlin and Stuttgart-Munich, and as it was not possible to inspect the Berlin district, all subsequent general remarks should be considered as referring to the latter area.

Die-casting Machines.—The plant is mainly of the Polak type, and, with one exception, is of an age which gives uneconomic production. An outstanding feature was the absence of heat temperature control in the holding pots in most plants.

Die Design.—While the workmanship was good, it was uninspired and not up to American or British standards. Due to shortage of alloying elements, inferior steels were being used. Core pulling was conventional —angle pins and hydraulic.

Finishing Equipment.—This was very ordinary and far below the U.S. and British standard. X-ray apparatus for inspection was encountered on only two occasions, and then it was doubtful whether the apparatus would be suitable for all castings and materials. The only inspection appeared to be of visual nature, even weight testing was not employed.

Production Rates.—These were low in comparison with America and Britain. The output per machine also seemed low.

Die-cast Materials.—These were confined to three, namely, magnesium (elektron), aluminium and zinc. The results on magnesium were good, but no better than in this country or America, and the reason for Germany's fairly high production in this material was probably controlled by supply.

Ancillary Contributions to Production.—Nothing in the way of new alloys, die steels or hydraulic mediums was seen. Hydraulic systems were usually water and soluble oil.

Conclusions.—The German industry is far behind U.S.A. and Great Britain. Only one firm would be considered first-class in either country, and that firm is Mahle K.G.—Fellbach (near Stuttgart).

FRANCIS MORTON & COMPANY, LIMITED, structural steelwork manufacturers, etc., of Liverpool, have appointed Mr. T. C. Grisenthwaite a director and London manager with offices at 52, Brook Street, W.1.

NEW CATALOGUES

Continuous Drying Stoves.—Covering the Acme Junior—a more recent development of the well-known Acme range of drying stoves—a brochure has been issued by the Foundry & Engineering Company (West Bromwich), Limited, Sandwell Road, West Bromwich. Though operating in one loop, the three stages of operation—initial rapid heating, oxidising and drying, and mechanically assisted cooling—are maintained. Normally, coke is used as fuel, but provision is made for the use of either gas or oil. Within the range are five sizes, carrying between 15 and 18 trays of varying dimensions. A few notes, with illustrations, are given of the Acme Minor and the Acme Cub, both of smaller size, and the Senior, which has multiple loops. The catalogue is of quite pleasing appearance, but the reviewer believes that better presentation would be effected by the elimination of the double border lines. Morover, the covers could have been used to better advantage.

Hydraulic Grinding Machines. There is real elegance in the design of a range of model "BY" grinding machines, which the Churchill Machine Tool Company, Limited, Broadheath, Manchester, describe and illustrate in a recently issued 30-page catalogue.

Exceptionally good use has been made of a combination of black and blue. There are four sizes in the standard range, which cover from 20 to 60 inches between the grinding centres. An outstanding feature of the grinders is the avoidance of motors within the machine so as to ensure rigidity—which one gathers is synonymous with absence of vibration.

STEELS FOR FOUNDRY FETTLING CHISELS

The type of steel for foundry fettling chisels has been the subject of much experiment and research, and Edgar Allen & Company, Limited, have found, by experience, that for all pneumatic gouges, chisels, etc., their Minerva tungsten chromium alloy steel is most suitable. It is employed throughout their own steel foundry.

For hand fettling chisels a carbon tool steel of suitable temper can be used, but as so many steel castings are to-day made from alloy steels, the general tendency is to use alloyed steel even for hand chisels, so that the consumption of carbon tool steel for this purpose is much less than formerly.

ITINERANT FOUNDERS

By T. R. HARRIS

Church bells are now considered the speciality of certain foundries, and peals are supplied to churches far and near. Things were otherwise a couple of centuries ago, when the transport system of the kingdom was in too bad a state to allow for the carriage of bells to remote country parishes. In such cases the founder would undertake the casting of the bells and establish a temporary foundry near to the church. The churchwarden's accounts often contain interesting references to these occasions, and the following extracts from those of St. Buryan, Cornwall, are a typical sample.

This bell was cast in the village, and a flaw in it was said to have been occasioned by a man suddenly jumping off a hedge, and so shaking the mould before the metal was cool. The diameter at the mouth was 46 in., and the charges in the churchwarden's account for 1738 are for casting the "Great Bell" and amounted to £33 19s. 11d. Some of the more interesting items in this account are:—Eighte hundred and a quarter of brick, and a "Hodgehead" of lime, costing £1 10s., whilst a further 10s. was paid for "Winsor and Stowerbridge bricks." These were presumably for the furnace, as the next entry is for "one hundred fourty 3 pounds of iron att 4d. per lb," and is specifically mentioned as "for ye furnace." One Robert Gibbs received 6s. 8d. for 5 days' work, and 10s. was spent "for stubbs for firing to dey (dry) ye moulds."

The mould was presumably made of clay, as 3s. 4d. was paid for "twenty reems of clay," whilst a man received 1s. 8d. for "two days to pick the clay." The bellfounder was paid £15 7s. in money, and "In span mettle four score and thirteen pound," £4 12s.

Two other items read: "Exps.: the day the bell was brought out of the peet (pit) and rowled into the tower 8s.," and "Exps.: the days the bell was put up in the tower and wayed and the beams put in the Lower Planchen (wood flooring), then spent on the parishners and the tradesmen for assisting to hall them up and other exp. att ye bell founder, 18s. 6d."

Other bells were also cast in the locality of the parish church, that of St. Neots, were said to have been cast in an orchard near the village in 1777. The Penningtons were perhaps the most noted of the itinerant founders of the West country, and many of the bells of Cornwall were cast by members of this family between 1668 and 1823.

PUBLICATION RECEIVED

Schedule of Carbon and Alloy Steels for General Service Applications. Published as S.T.A.5, for the Ministry of Supply, by the British Standards' Institution, 28, Victoria Street, London, S.W.1. Price 7s. 6d., post free.

Most users of steel are familiar with S.T.A. schedules, and they will welcome the appearance of this book, which in just over a hundred pages now presents what must surely be complete coverage. The major use of the schedule is, in the reviewer's opinion, not for the storekeeper, who by now should regard the ordering of material as routine, but rather for the designer. By the careful choice of standardised sections, not only can he reduce waste, but can ensure ease of machining or reduce weight by the choice of stronger material. The "general service applications" included in the table exclude tool steels, and many types of special lines. It does, however, cover a wide range of case-hardening and nitriding steels; and rust-resisting steels and the like.

METAL PRICE UNCERTAINTIES

By "Onlooker"

To hold the price of any commodity at a steady level is no easy task, and it may be taken as axiomatic that only the powers of the Government are great enough to achieve this over a prolonged period. Certainly, during the war, remarkably successful results were obtained in the field of stability, and of this no better example exists than the non-ferrous metals. It is generally understood that in the concluding stages of the conflict it was necessary to resort to the use of subsidies, at any rate in tin and copper; but at times of National danger such a course can be amply justified. It is worth noting that the United States adopted similar tactics, and they are still being pursued, but there is certainly every likelihood of the principle being abandoned at the end of the half year. Labour interests are pressing for their retention, but it is a moot point whether this pressure will be successful. In respect of copper, some very high premiums have been paid to keep certain domestic mines operating, and there have also been expenses in connection with the importation of foreign copper.

Nevertheless, with the termination of war, there has been a re-opening up of markets, and the phenomenon of the "world price" has made an effective reappearance after many years. This means in effect that some business is beginning to flow through the merchants' and distributors' channels which have been closed, to a great extent, since 1939. The amount of copper passing is not as yet very great, but these interests are beginning to feel their feet to some extent, and there is a tendency to "make a market," or in other words for the middlemen to begin to accumulate stocks. This movement is unlikely to go very far in the absence of any facilities for hedging, but a start has been made and it is noteworthy that these buyers do not seem to be afraid of holding copper at 12 cents, which is equal to about £68 per ton. Here in Britain the consumer pays only £62 delivered for his metal, but his gain is the taxpayer's loss, for the Ministry of Supply now has to pay the world price, *i.e.*, 12 cents at least (for electro), and possibly rather more. Is it surprising that there is general expectation of a rise in copper in the near future?

Tin Situation

In tin an analogous situation obtains, for at £300 the British buyer is securing his cover below the world price, and at a figure less than the average purchase price of the Ministry of Supply. Tin interests in the Far East are reported to be disgruntled over the fact that they are expected to sell on the basis of £300, whereas other centres of production, such as Bolivia, are given a higher price. Zinc, selling in the U.K. at £32, costs nearer £50 to procure from overseas sources of supply, and the concentrates which form the basis of our domestic production are purchased at a rate fixed on the world price of the metal.

Lead, that tragic example of how far wrong the system of bulk buying can go, is now available on a rationed basis to the British users at £39, but it costs a good deal more than that when supplies are wanted from abroad, and that means all the time for there is no native production worth speaking of. Aluminium is something of a puzzle, for which £85 is about the equivalent of 15 cents, it may be doubted whether our home costs of production from imported bauxite are such as to allow sales at a margin of profit to the producers without a subsidy.

Not for the first time in the history of non-ferrous metals matters have not turned out as expected, for undoubtedly there was a strong anticipation that the trend of values would be downwards from the wartime levels. Conditions of superabundance in supply were prophesied, but owing to the maintenance of big consumption on one hand and strikes at some mines, with falling output at others, on the production side, not to mention high costs, the statistical position is developing along lines which point to higher prices. Were a free futures market to be restored in London the facts of the situation as to values would be established in a manner which would not admit of doubt. The quotations would be factual, instead of artificial, as at present declared by the British Government. Doubt would be dispelled and confidence restored. There can be no question that the sooner real trading in metals is re-established the better it will be for all concerned. Incidentally the existence of a terminal market in London gives the trade in this country the opportunity to take a stand, and give effect to its own ideas of what values should be.

EXPORT OF SURPLUS MACHINE TOOLS

Mr. S. F. Steward, Director-General of Machine Tools, Ministry of Supply and Aircraft Production, speaking at a luncheon organised by the British Engineers' Association, said that at the present time, after machines had been on offer through the disposal records for four months they could be purchased for export at prices 20 per cent. above those at which they had been offered to the home industry. It was proposed to reduce this period to two months and to remove the additional 20 per cent. This would still give British industry ample opportunity to acquire the machines through the records, but it would provide a better opportunity for the export of machine tools for which there was no pressing demand at home, and by clearing stores and factories would make way for a greater intake of better machines into the records.

At an early site sale it was proposed as an experiment to operate the present procedure for a week as it was his experience that it was during the first week of a site sale that the local industrialists secured the machines they needed. At the end of the week it was proposed to make the residue of surplus machines in the factory available for purchase by competitive tender, either on behalf of home users or for export.

THE USE OF gas-turbine locomotives, based on experience obtained in connection with jet propulsion, is under consideration by the Great Western Railway.

CENTRIFUGAL CASTING APPLIED TO ALUMINIUM ALLOYS*

By E. J. BASCH, P. BLACKWOOD, and J. PERKINS

Centrifugal casting describes castings made by pouring a measured quantity of metal into a mould which is spinning, or which is spun immediately after the metal is poured, so that the metal is caused to rotate. The following is a description of the generally accepted theories covering this method of casting.

The centrifugal force causes the metal to flow toward the mould walls, and along them, and this force on the rotating metal is utilised to obtain intimate contact between the mould and the metal. Gases in the metal are removed by compression, and the centrifugal force also is said to aid in purifying and cleaning the metal by the well known separator action, throwing the metal to the outside, and leaving the oxides and other materials of less density than the molten alloy along the inside surfaces of the casting, where they can be removed by machining. Since solidification is directional, from the outside periphery inwards, this pressure ensures that the molten alloy remaining on the inside will fill the interdentritic shrinkage which occurs. Spinning must therefore be continued until the casting has solidified completely.

The metal must be poured smoothly, without any interruptions, or laps will occur in the casting. It is desirable to pour the metal into the mould quickly, but some castings may require modification of the pouring speed by tapering off on the speed as pouring progresses. Spinning can be done with the axis of the mould vertical, horizontal, or sloped at any angle between the two. Centrifugal casting is divided into three types:—

(*a*) *True Centrifugal Castings.*—This is the best known of the methods of centrifugal casting. The die is rotated about its own axis during solidification, and no central cores are used. The casting may have a hole through the centre, the diameter of which is determined by the amount of metal poured. If so much metal is poured that no hole is formed, the central portion will not be equal in quality to the outer portion. Since measured amounts of metal are poured and no sprues, gates, or risers are required, the yield of casting to metal may approach 100 per cent.

(*b*) *Semi-Centrifugal Castings.*—Castings of this type are very similar to type (*a*), except that central cores are used to form irregularly shaped contours of the bore of the casting. Unless great care in design of the die is exercised, directional solidification will not take place. Sand or plaster of paris cores in metal moulds, or differentially heated or cooled metal moulds will help to overcome obstacles to directional solidification. As in type (*a*), metal in the centre of the casting is not as good as the outside.

(*c*) *Centrifuged Castings.*—This method of casting is used for shapes which are unsymmetrical and cannot be rotated around their own axes. Moulds are arranged around a central pouring hole in the centre of rotation, with gates leading to each from this central down gate. Castings of this type must be rotated vertically, and a single mould resembles a wheel, with castings around the rim at the end of the spokes. The metal is poured into the "axle." The impressions may be arranged so that they lie on the rims of concentric wheels.

By stacking moulds, many castings can be made at one time. The quality of these castings will probably not be quite equal to true centrifugal castings, since it is more difficult to obtain directional solidification in this method.

Engineering Characteristics of the Finished Product

The greatest engineering advantage of centrifugal over other types of castings is their uniformity, which allows greater stresses to be assigned to the parts. Although test-bars cut from centrifugal castings do not always show higher properties than test-bars cut from other castings or forgings, in most cases an end use test does show a higher value. That is, of two identical parts manufactured by two different methods, such as centrifugal cast and permanent mould cast, or centrifugal cast and forged, actual service tests of the parts in question when cast centrifugally often give better results than parts made by other methods.

The dimensions of centrifugally cast parts can be held to $\pm \frac{1}{32}$ in. or better for machining where required. The surface finish of these castings if produced in a coated mould is at least as good as permanent mould castings.

Centrifugal castings are heat-treatable.

Design Characteristics

Although popular belief has it that only castings which can be spun on their own axes are good subjects for this process, it has been demonstrated that almost any part can be cast in one of the three classes of centrifugal casting, although some parts which are long and thin with involved contours are obviously not as well suited to this process in metal moulds as chunkier ones. An alloy can be cast in thinner sections centrifugally, because of the induced pressure, than it can be cast in static moulds.

Cores of baked sand, plaster of paris, or metal can be used to form cavities in the castings, and if the metal cores cannot be removed in one piece from the casting, it is possible to use collapsible cores as in other methods of casting.

Moulds used in centrifugal casting may be made from steel, cast iron, green or dry sand, or graphite. Metal dies used in this process can either be cast, or machined from solid stock, but it is obviously much cheaper to cast them. In doing this, baked sand cores are used so that the dies can be cast very close to

* Extracted from a Paper read before the American Society of Automotive Engineers.

Centrifugal Casting

desired dimensions; in some cases no machining is required.

Although alloy cast irons have been used, one company has had very good success with a cast iron having the following analysis:—C, 3.10 to 3.30; Si, 2.10 to 2.20; Mn, 0.60 to 0.80; S, 0.10, and P, 0.10 maximum percentage.

These dies are used without any heat treatment. Not enough use has been made of this process to determine the life of dies for aluminium centrifugal casting, although the dies used so far show no signs of failure. They are maintained at 90 deg. to 150 deg. C., by means of artificial cooling, or by changing dies to give them an opportunity to cool. The die wall thickness should be such that a rapid chill is affected. A general rule to follow is to use dies 2½ times as thick as the casting thickness.

Baked sand moulds are used for castings to be made by the centrifuged method. The following procedure will give good results. Patterns are designed so as the parts to be cast are arranged around a centre pouring sprue. A core sand mix is uniformly rammed up on the pattern. The mould is sprayed green with silica wash and then baked. By this method a good strong open dry sand mould can be produced, into which the molten aluminium can be spun.

The core mix is made up of 80 per cent. sharp sand, 20 per cent. bank sand, with 1½ qts. of cereal binder and ½ qt. of core oil per 100 lbs. of sand, the moisture content of the green sand is from 2.50 per cent. to 3 per cent.

The silica wash used is made up by mixing in a separate tank, a bentonite paste comprised of 20 qts. of bentonite in 36 galls. of water at 82 deg. C.; 12 galls. of this paste are then mixed with 48 galls. of water and 5 galls. of Glutin. The beaumé is brought up to about 3 deg. C. by the addition of silica flour. The mix is kept agitated in the tanks.

The moulds are sprayed in the green state to facilitate cleaning operations and to ensure a thoroughly dried sprayed surface. These cores are then transferred to the assembly stations.

The copes and drags are located together with any inside cores set. Each set of copes and drags is then stacked up on bottom plates. A special top plate is adjusted and bolted down with four bolts. The assembly is then picked up by an overhead hoist and lowered in the spinning pot. Wooden wedges are used to centre the cluster so as to facilitate pouring.

Green sand moulds have been successfully used. The mixture used contains about 80 per cent. sharp sand and 20 per cent. bank sand. To 100 lbs. of this mixture about 10 lbs. of white clay binder is added. The moisture content of the mix must be kept very low; about 1½ per cent. is recommended.

Graphite offers many advantages as a mould material. It is only about one-third as heavy as cast iron or steel, yet has a heat conductivity about three times as great. It is very easily machined, and when handled carefully seems satisfactory for small to medium production runs. Its use is still in the experimental stage.

Sprays

The use of metal moulds for centrifugal castings seems to require a coating on the mould walls. Various materials are used:—(1) A mixture of graphite and sodium silicate in water gives good results; (2) another good coating is produced by the use of the following mixture: To 9 grms. soap flakes in 800 ml. hot water, add 30 ml. sodium silicate, plus 2 ml. hydrochloric acid, plus 18 ml. water. Take 200 ml. of the above stock solution and add 300 grms. zirconium oxide.

These should be sprayed on the hot die while it is rotating.

Equipment

Most of the centrifugal castings are made with the mould spinning either vertically or horizontally. There are advantages to each method. Horizontal spinning is used to produce pipe and other true centrifugal type castings, particularly where the length of the part exceeds the diameter. The inside walls are cast parallel in this method, and speeds are generally lower than for castings spun vertically. A disadvantage is that the metal cannot be poured into the mould as quickly as in the vertical moulds. This causes the casting to have lower physicals.

Vertical spinning can be used for all three types of casting, except for true centrifugal castings, where the length exceeds twice the diameter, since the speed which would be required to cause the metal to rise along the mould walls would be excessive, particularly if the central walls are to be held to a small taper. In vertical true centrifugal casting, the inside hole is always parabolic, the taper depending on the speed.

Speeds used vary from 60 r.p.m. to 2,000. It has been established that no benefit is obtained by increasing the speed over that required to get the poured-in metal in rotation and into the die cavity quickly. Apparently an increase in speed offers no advantage, except to overcome in vertical casting, the parabolic shape in the bore of a true centrifugal casting, and may cause cracking of the part.

By means of proper design, solidification can usually be made to take place directionally, from the outside surface to the centre. If the wall thickness of the casting is too great, heat losses from the centre and ends would become equal to that from the outside surface, and directional solidification would be lost. Voids might then occur along the plane where the two solidifying sections meet. The moulds and machines must be well balanced before rotating or "banding" may occur, which causes sections of weakness.

Flushing

If a ring is placed over the pouring end of the mould, with a hole equal to the inside diameter of the part being cast, and a slight excess of metal is poured in, the excess is thrown out, and in the material so thrown out will be found much of the oxide which usually accumulates in the centre.

Production

The yield of weight of castings to weight of metal poured, is generally considerably higher in centrifugal casting than in static casting.

With a well-trained crew of men, it is possible to produce castings at a high rate. For example, a crew of 21 men, with a series of 12 automatic vertical machines on a moving turntable, can pour 200 moulds an hour. This includes setting sand splash-cores, internal cores, assembling stacked moulds, and removing castings from the mould. (Since each mould may contain up to 144 castings, this would be equivalent to a maximum of 28,800 castings per hour, or a production of 1,370 castings, or 9.5 moulds per hour per man, this is of course a maximum.) All moulds cannot be designed for so many pieces. A truer average would be given by assuming 10 to 12 castings per mould.

Inspection can be done by X-ray, visual inspection or zyglo. Since centrifugal casting is noted for the uniformity of its products, after the cycle has been proved in, a spot check X-ray is usually satisfactory.

Metal Control

Aluminium alloys are notable for their tendency to dissolve iron and absorb gases. Since iron in most aluminium alloys reduces elongation fairly rapidly, every precaution should be taken to prevent iron pick up.

Aluminium reacts with many gases, the most important of which, hydrogen and oxygen, are present in the foundry from combustion gases, hydrocarbons, water vapour, etc., and exert a deleterious effect on the alloy. Oxides are introduced into the melt by melting scrap castings, gates, etc., which are covered by the oxide film which forms immediately on all aluminium surfaces. Each time a surface is disturbed, as by stirring, pouring, etc., more oxide film is produced. This causes sluggishness of the metal during casting and lowered physical properties; fused oxides cause hard spots, which make machining difficult.

When gases are dissolved in the melt, they appear in the casting as the so-called pin hole porosity, causing lack of pressure tightness and loss of physical properties of the material. Because of the deleterious effect of these gases, it is desirable to prevent contact between the melt and vent gases, oils, etc. Overheating of the metal increases the amount of gases in solution; and also increases the oxidation, and the rate of solubility of iron.

Both of these conditions, oxides and gases in the metal, can be corrected by the proper melting and fluxing procedures. However, the fear of oxide dispersion in the casting does not seem to be borne out by experience. Special practices for centrifugal casting of aluminium consist only in pouring metal at a temperature approximately 40 deg. C. lower than would be required for the same part statically cast.

Apparently any alloys of aluminium which can be sand, gravity or pressure die cast can be cast centrifugally. It is felt that alloys with a short solidification range are more desirable than those with a long freezing range. The amount of segregation occurring in centrifugal casting of aluminium is debatable. Some evidence has been offered which indicates that a small difference in analysis exists between the inside and outside of a casting. The difference is not large, but it has not been proved exactly how much variation in analysis must be expected. It has been explained in two ways. One explanation assumes that the first solidification will occur at the cooler outside walls, leaving the residual liquid nearer the eutectic composition. The other explains any segregation by the different centrifugal forces on the residual liquid and various solid constituents in the mixture. Since in the centrifugal casting of copper lead alloys (the density of copper is 8.89 grms. per ml., compared to lead at 11.0 grms. per ml.). Some producers of copper 20 per cent. lead alloys claim to encounter practically no segregation, it is difficult to explain any segregation of aluminium alloys by the line of reasoning which explains segregation as due to the centrifugal force on the components. Since a large temperature difference exists in the melting points of copper and lead (M.P. of copper = 1,083 deg. C., lead = 327 deg.) and in the solidification, copper solidifies before the two liquid phases of lead and copper, followed by lead itself, it is also not reasonable to agree with the residual eutectic theory.

HYPERSONIC TESTING

The Brush Development Company, Cleveland, Ohio, have developed a "Hypersonic" testing apparatus. In application a transmitter connected to an electronic controller passes a beam through a specimen which, depending on its properties, modifies the beam, and the resulting energy pattern is picked up on the side opposite the transmitter by means of a microphone. A critical set of radiation frequencies and electro-acoustic designs may be selected so that the resultant beams through the material are highly modified by any given type of flaw in any particular material. The actual detection and identification of the flaw or defect may be indicated in a number of different ways. Generally, the use of a liquid as the transmitting medium is desirable, the reason being that fluids such as water and oil give better coupling between the transmitter, the material under inspection and the receiver, at supersonic frequencies.

HIGH NICKEL STEEL TUBING

A new 9 per cent. nickel steel tubing, produced by Babcock & Wilcox Tube Company in the United States, and said to be the first time this high nickel-bearing steel has been made available in tubular form, is capable of giving Charpy impact values as high as 25 ft.-lbs., even at a temperature of minus 320 deg. F. The material is claimed to offer high resistance to attack by alkaline media and to low-temperature embrittlement.

IMPORTS AND EXPORTS OF IRON AND STEEL

BOARD OF TRADE RETURNS FOR JANUARY

Returns now published by the Board of Trade contain figures of Britain's overseas trade in January. The following tables give the imports and exports of iron and steel and manufactures thereof. Monthly averages for 1938 are shown in the first column for purposes of comparison.

Total Exports of Iron and Steel.

Destination	Monthly average, 1938	Month ended January 31	
		1945	1946
	Tons	Tons	Tons
Eire	4,643	1,612	6,569
Channel Islands	618	—	239
Palestine	673	249	2,355
British West Africa	4,145	1,067	4,792
Union of South Africa	19,256	2,172	16,175
Northern Rhodesia	1,714	989	135
Southern Rhodesia	3,018	208	3,593
British East Africa	2,161	342	1,936
British India	13,222	1,386	6,945
Burma	1,543	—	1,292
British Malaya	5,549	—	2,451
Ceylon	2,169	1,098	503
Hong Kong	1,966	—	1,535
Australia	14,241	338	1,101
New Zealand	10,990	415	3,161
Canada	7,117	91	561
British West India Islands	3,687	223	1,796
Anglo-Egyptian Sudan	691	176	1,078
Other British Countries	1,826	351	1,211
Soviet Union	362	139	—
Finland	1,467	—	18
Norway	1,689	—	8,021
Iceland	55	32	591
Denmark	7,271	—	7,315
Poland	207	—	432
Netherlands	4,297	—	12,165
Dutch East Indies	2,276	—	—
Dutch West India Islands	205	2	1,133
Belgium	1,694	—	6,241
France	1,116	15	6,464
Portugal	643	34	4,920
Portuguese East Africa	1,185	9	116
Spain	647	631	388
Italy	428	18	2
Greece	146	—	2,074
Turkey	1,146	63	1,848
Egypt	2,867	768	13,052
Iraq	2,145	81	3,810
Iran	9,197	2,155	11,150
China	1,844	—	—
U.S.A.	182	6	32
Venezuela	390	23	2,176
Ecuador	133	2	426
Chile	524	10	254
Brazil	1,416	105	9,689
Uruguay	632	8	950
Argentine	6,613	12	3,771
Other Foreign Countries	9,642	999	14,176
Total	159,656	15,829	168,642

THE GOVERNMENT are anxious to have summer holidays spread over June, July, August and September in order that the maximum number of people should have the opportunity to recuperate and rehabilitate themselves, and so make the maximum contribution to national production for which the Prime Minister has asked. Towns are to be encouraged to have a fixed holiday week.

Total Imports of Iron and Steel.

From	Monthly average, 1938	Month ended January 31	
		1945	1946
	Tons	Tons	Tons
British India	12,968	12,016	2,727
Australia	3	—	7,784
Canada	9,781	2,314	7,799
Other British Countries	466	41	69
Sweden	7,483	—	94
Norway	2,814	—	538
Belgium	22,806	—	4
Luxemburg	4,883	—	—
France	21,446	—	—
U.S.A.	16,724	83,945	6,511
Other Foreign Countries	12,644	—	7
Total	112,023	98,316	25,533
Iron ore and concentrates—			
Manganiferous	5,190	—	6,900
Other sorts	425,156	199,915	410,580
Iron and steel, scrap and waste, fit only for the recovery of metal	52,684	373	26,032

Exports of Iron and Steel by Products.

Product	Monthly average, 1938	Month ended January 31	
		1945	1946
	Tons	Tons	Tons
Pig-iron	7,828	126	2
Ferro-alloys, etc.—			
Ferro-tungsten	43	—	58
Spiegeleisen and ferro-manganese	433	—	9,014
All other descriptions*	87	109	72
Ingots, blooms, billets and slabs	812	80	108
Iron bars and rods	266	17	630
Sheet bars and tinplate bars	1,032	29	103
Wire rods and bright steel bars	814	90	2,382
Other steel bars and rods	8,500	1,004	19,937
Special steel	411	233	1,241
Angles, shapes and sections	5,617	875	11,301
Castings and forgings	135	7	121
Girders, beams, joists and pillars	2,789	181	5,911
Hoop and strip	3,115	103	4,397
Plates, ¼ in. thick and over	10,913	655	17,866
Black plates	1,211	166	1,037
Black sheets	5,292	25	1,998
Galvanised sheets	12,244	30	773
Tin plates	26,608	747	9,291
Tinned sheets	117	107	64
Terneplates	360	252	—
Decorated tinplates	364	119	112
Cast-iron pipes, up to 6 in. dia.	4,077	158	2,989
Do., over 6 in. dia.	3,580	445	3,919
Wrought-iron tubes	18,332	1,687	15,187
Steel rails	8,833	2,135	22,171
Sleepers and fishplates	2,115	82	14,837
Other railway material	2,231	828	1,306
Wire	4,599	139	4,055
Wire manufactures	2,458	803	46,029
Nails, tacks, etc.	317	475	789
Rivets and washers	711	69	651
Wood screws	209	163	479
Bolts, nuts, and metal screws	1,464	346	1,312
Stoves, grates, etc.	762	289	447
Sanitary cisterns	234	31	42
Fencing material	427	—	191
Anchors, etc.	528	130	225
Chains	534	251	573
Springs	328	79	301
Hollow-ware	892	1,176	4,411
All other manufactures	18,036	2,063	7,207
Total	159,656	15,829	168,642

* The figures for 1946 are not completely comparable with those for earlier years.

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NEWS IN BRIEF

THE KING will open in London, on June 17, the Empire Scientific Conference, organised by the Royal Society.

INTERNATIONAL COMBUSTION, LIMITED, announce that orders on hand are the largest in the history of the company.

THE VETERAN 21,250-TON battleship "Iron Duke" has been sold to Metal Industries, Limited, Glasgow, for breaking up.

THE TEES VALLEY WATER BOARD is to spend nearly £2,000,000 to meet future water requirements in industrial Tees-side.

GOVERNMENT INSTRUCTIONS have been received for the completion this year of 30,000 steel-framed houses by British Steel Houses, Limited.

THE WHITEHEAD IRON & STEEL COMPANY, LIMITED, are planning to spend £1,000,000 on major developments at their works at Newport (Mon.).

FIELDING & PLATT, LIMITED, of Gloucester, have received an order amounting to £250,000 for axle and tyre equipment from the Argentine State Railways.

THE BRITISH WELDING RESEARCH ASSOCIATION has removed from 2, Buckingham Palace Gardens, London, S.W.1, to 29, Park Crescent, London, W.1.

EXPANSION IS PLANNED of a factory started at Darlington last November, by Daralum Castings, Limited, for the manufacture of domestic hollow-ware.

THE LIST OF PRICES of non-ferrous scrap metals issued by the Ministry of Supply and Aircraft Production on December 31 last will remain current until April 30.

NINETY-NINE EMPLOYEES whose aggregate of service with W. H. Dorman & Company, Limited, engineers and ironfounders, of Stafford, totals 3,338 years, have been awarded long-service certificates. Five of the men have fifty years' service.

THE BRITISH WELDING RESEARCH ASSOCIATION has issued a memorandum (T. 15) detailing the recommended technique for making butt welds in mild-steel plating in the downhand position with overhead back runs, and in the vertical and horizontal positions.

A NEW TYPE of annealing plant, which may be the first production model of its kind to be used in this country, is to be installed by John Maddock & Company, Limited, malleable-iron founders, of Oakengates, Salop. The plant, which is electrically operated, is entirely automatic.

BIRMINGHAM UNIVERSITY has received for the development of its department of metallurgy a gift totalling nearly £137,000 by constituent associations and members of the British Non-Ferrous Metals Federation in response to a special appeal. The gift will enable the department to make a start on its plans without delay.

THE BRITISH ALUMINIUM COMPANY, LIMITED, announce that their prices for pure aluminium sheet, coiled strip and circles have been revised. Their prices for aluminium/manganese BA.60 alloy will be the same as for pure aluminium until further notice. The revised prices will apply to all material despatched on and after March 1.

THE MINISTER OF SUPPLY AND AIRCRAFT PRODUCTION has informed representatives of the engineering unions that he will discuss their proposals for the reconstruction of the engineering industry and the setting up of an advisory engineering board with other Government departments likely to be interested and with representatives of the engineering employers.

MR. J. W. BELCHER, Parliamentary Secretary to the Board of Trade, speaking at a meeting of the Engineering Industries Association in Manchester, said he was fairly certain that they would find, when the April Budget came to be presented, that the Chancellor did know that it was necessary for steps to be taken to assist British industry to accomplish the change-over as speedily and with as little dislocation as possible.

TEES-SIDE STEEL will be used exclusively in the construction of a floating dock which the Furness Shipbuilding Company, Limited, have contracted to build for Swedish owners. This dock, which will be 468 ft. 9 in. in length, 100 ft. wide and 42 ft. deep, with a lifting capacity of 9,000 tons, has been ordered by the well-known Stockholm shipping company Rederiaktiebolaget Svea, who run a regular steamship service between Sweden and the North-East Coast.

THE COUNCIL OF INDUSTRIAL DESIGN is sponsoring an exhibition of industrial design, which will be opened on September 24 at the Victoria and Albert Museum, London. The products, which will be shown at the exhibition, of particular interest to the solid-fuel and appliance industries are those devoted to domestic heating, cooking and hot-water supply. The Council have asked the Coal Utilisation Joint Council to assist them in arranging for the submission of exhibits by the industry.

FOR THE CURRENT academic year over 300 British Council scholarships for study in Britain have been awarded to students from overseas. The scholarship-holders have come from 45 different territories in the Empire, Europe, Latin-America, the Near and Far East. Besides those studying various subjects at Universities, some 20 students have been placed with a number of large steel and engineering firms, including the English Electric Company, English Steel Corporation, General Electric Company, International Combustion, Metropolitan-Vickers, and Newall Engineering Company.

FEBRUARY IRON AND STEEL OUTPUT

Official figures of pig-iron and steel production for February, with comparative figures, are given below:—

Month.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
	Tons.	Tons.	Tons.	Tons.
February, 1946 ..	146,200	7,600,000	247,200	12,852,000
January, 1946 ..	143,600	7,465,000	228,600	11,887,000
February, 1945 ..	136,700	7,109,000	241,400	12,553,000
January, 1945 ..	172,000	6,610,000	216,300	11,245,000

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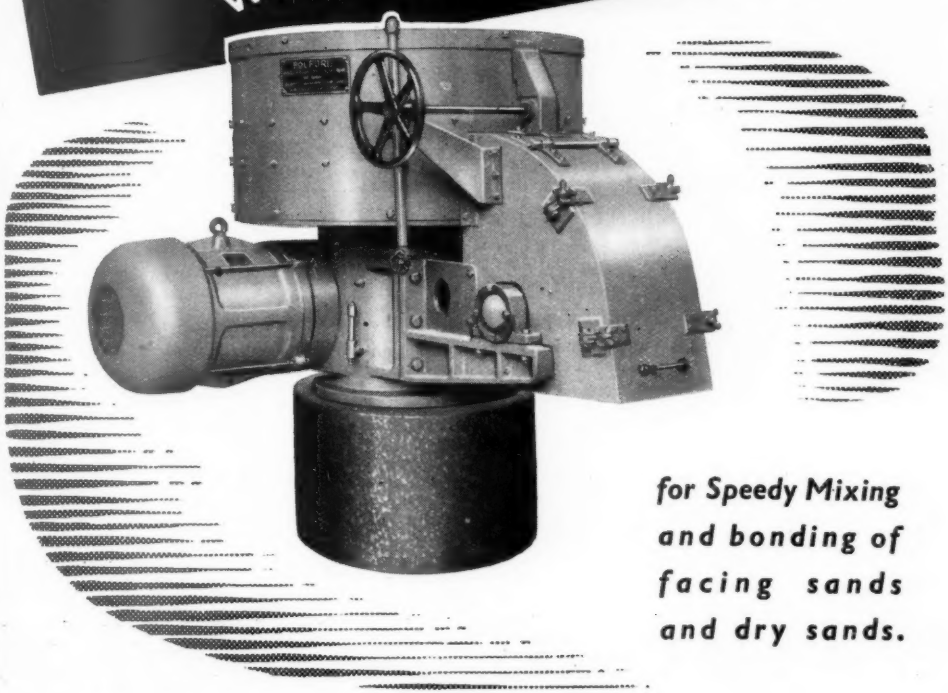

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PERSONAL

VICE-ADMIRAL ARTHUR D. READ has been appointed London director of the Fairfield Shipbuilding & Engineering Company, Limited.

SQUADRON-LEADER D. W. CROSSE has joined the board of Porn & Dunwoody, Limited, Diesel engineers, etc., of Southwark, London, S.E.1, as assistant managing director.

ADMIRAL L. E. H. MAUND, who commanded the "Ark Royal" at the time of her sinking, has been appointed manager and a director of A. Kershaw & Sons, Limited, precision engineers, etc., of Harehills Lane, Leeds.

MR. JOHN HENRY has been elected president of the South African Association of Production Engineers. A native of Hamilton, Lanarkshire, he went to South Africa 12 years ago as general works manager for Dorman, Long (Africa), Limited, Johannesburg.

MR. GEORGE GUMMER, chairman and managing director of Gummer's, Limited, of Rotherham, has been elected president of the Northern Employers' Brass Founders' Association. He succeeds Mr. A. Ellis, managing director of Peglers, Limited, of Doncaster, who is to be president of the national body.

MR. A. J. JACK has been appointed manager of the London office of Hadfields, Limited, the scope of which is being extended. He was previously in charge of technical development, and is a son of the late Mr. A. G. M. Jack, at one time deputy chairman of the company.

MR. EDWARD C. GREIG, who has held the position of chief labour superintendent of the United Steel Companies, Limited, for the past 24 years, is resigning from that position as from March 31, for reasons of health. His successor is MR. DESMOND HALAHAN. Mr. Greig will continue to serve the company as labour consultant.

MR. W. H. SALMON, steel foundry superintendent, of Hadfields, Limited, has been appointed technical sales representative for steel castings. He is lecturer in foundry practice and science at Sheffield University, and president of the Sheffield branch, and a member of the Education Committee, of the Institute of British Foundrymen.

MR. J. S. WILLS has been elected chairman and managing director of National Electric Construction Company, Limited, in place of MR. R. J. HOWLEY, who retains his seat on the board. MR. H. C. DRAYTON and MR. K. E. GARCKE have resigned. MESSRS. R. P. BEDDOW, R. W. BIRCH and J. C. TAITE have been appointed directors.

THE EARL OF DUDLEY has been appointed deputy-chairman of the Great Western Railway Company in succession to the Hon. Sir Edward Cadogan. Lord Dudley is chairman of Round Oak Steel Works, Limited, the Earl of Dudley's Baggeridge Colliery, Limited, Horseley Bridge & Thomas Piggott, Limited, and a director of a number of other companies.

MR. ROLAND FINCH has recently retired from the post of joint managing director of Imperial Chemical Industries, Limited (Metals Division), after 42 years' service. He has joined the staff of the British Non-Ferrous Metals Federation, and will continue to act as chairman of the International Relations Sub-committee of the Federation and chairman of the Non-Ferrous Metals Export Group.

MR. B. H. THORP, who has been appointed mechanical engineer to the Copper Development Association, served his apprenticeship at Smithfield Ironworks, Leeds, and spent a year in the drawing office of Thorp & Atkinson, consulting engineers, Leeds, before going on to Leeds University. He later spent three years on the oilfields at Yenangyaung, Burma, and in 1937 Mr. Thorp joined the scientific staff of the Admiralty.

MR. L. CHOQUENET, president of the Société Anonyme des Fonderies et Ateliers L Choquent, of 19 rue Charles-Brunette Chauny, Aisne, France, is anxious that his 22-year-old son should be accepted as a pupil in a British foundry starting from next June. On his side, he would be pleased to accept a young technician similarly circumstanced to train in his foundry. He manufactures plant for sugar refineries and glass-bottle makers.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Birkenhead, March 28—Supply and erection of a cast-iron water-cooled condenser of the vertical tube type, having a capacity of 3,000,000 cub. ft. per day, for the Town Council. The Gas Engineer, Gas Office, Hind Street, Birkenhead.

Huddersfield, March 28—Cast-iron materials for the 12 months ending March 31, 1947, for the Corporation. The Borough Engineer and Surveyor, High Street Buildings, Huddersfield.

Ryde, April 1—Construction and maintenance of about 3 miles of 12-in. dia. spun-iron water main, for the Borough Council. Lemon & Blizard, consulting engineers, Lansdowne House, Castle Lane, Southampton. (Fee £5 5s., returnable.)

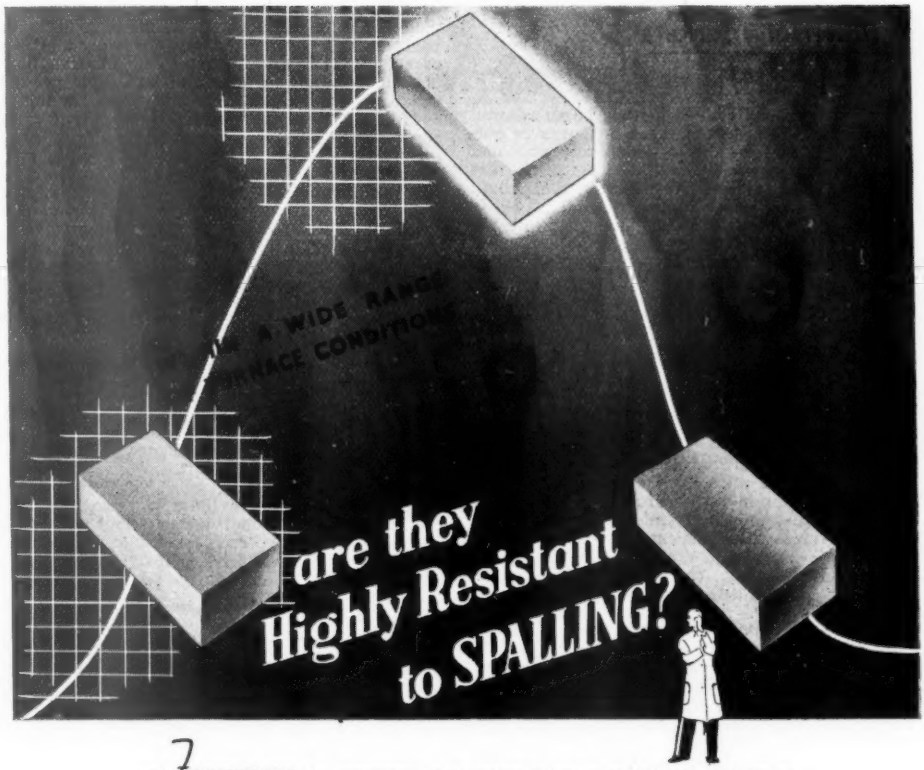
Warwick, March 25—Provision and laying of 600 yds. of 4-in. dia. cast-iron water mains, for the Rural District Council. Mr. Sholto Douglas, engineer, 50, Priory Road, Kenilworth. (Fee £2 2s., returnable.)

OBITUARY

MR. JOHN SCHOFIELD, a director of J. & H. Schofield (Textile Machinery), Limited, of Spotland, Rochdale, died on March 5, aged 52.

MR. HARRY ELPHICK, formerly chairman and managing director of William Jacks & Company (Malaya), Limited, has died after three months' serious illness. He died on March 4 at the 47th British General Hospital.

SIR CHARLES HIPWOOD, K.B.E., C.B., until recently director of the National Union of Manufacturers, died at Chislehurst on March 11. He acted for a time from March, 1919, as Controller of Coal Mines. Sir Charles had a distinguished career in the Civil Service.



FIREBRICKS in common with many other materials expand upon heating. Most of the expansion takes place at temperatures below 900°c. This means that stresses are created within the firebricks owing to differential expansion throughout their length. During the cooling process the dimensional changes are reversed but equally great stresses are set up. Glenboig firebricks are manufactured from raw materials which are graded to give the greatest possible accommodation to internal stresses consistent with the preservation of ample strength and high refractoriness. This characteristic is of great value under conditions where sudden changes of temperature cannot be avoided.

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THE GLENBOIG UNION FIRECLAY CO. LTD., 48, WEST REGENT STREET, GLASGOW, C.2

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Raw Material Markets

IRON AND STEEL

More amply supplied with high-grade imported ores, blast-furnace men are maintaining a high rate of output. Production of low- and medium-phosphorus and hematite irons may possibly be in excess of current requirements and refined-iron makers, too, could conveniently handle more business than has been forthcoming during recent weeks. The switch of some of the furnaces from foundry to basic pig-iron is, however, viewed with apprehension. No doubt this change has been dictated by stern necessity. The expansion of steel production has become imperative. Nevertheless, the change is bound to intensify the stringency in regard to foundry supplies, and this at a time when the needs of the light-castings industry are increasing. Careful distribution may ameliorate the position, but no more than a pint can be drawn from a pint pot and the plain fact is that production of high-phosphorus iron is below the level of bare necessity.

British steelmakers have made a good response to the heavy calls of the re-rolling industry. Imports of semis have fallen far below the minimum figures of the war period, but the sheet and light section mills have been provided with sufficient material to sustain full production. Sheet mills are amply provided with British-made bars, but the scarcity of billets persists, and as the stocks of defective material have been almost wholly dispersed, the re-rollers are becoming anxious for news of the arrival of further cargoes of Dominion steel which are on order.

So heavily are the plate mills booked, particularly for light and medium sizes, that there is little scope for the acceptance of further orders except for Period 3. There are plenty of export orders on offer, but the surplus tonnages available for shipment are very small. The heavy section, rail and wire mills are also handling maximum outputs, while the sheet mills can only consider new business on the condition that buyers are prepared to wait many months for delivery.

NON-FERROUS METALS

There is no improvement to report in the copper supply position in this country and it is expected that supplies will remain short for some time to come. Similar conditions apply in the United States. American copper production figures for February showed a marked decline all round. According to the American Copper Institute, production of crude metal was 41,813 short tons, as compared with 72,721 tons in January. Refined output was 45,584 (69,008) tons, while domestic deliveries were 84,716 (115,601) tons. Stocks of refined copper at the end of February totalled 70,282 tons, against 72,799 tons at the end of the previous month.

Tin prices were under review at Question Time in the House of Commons on Wednesday of last week. Mr. Gammans asked the Secretary of State for the Colonies whether he was aware that the price of Malayan and Nigerian tin was now only £300 per ton as against £422 per ton for South African tin, £350 per ton for Belgian Congo tin and £345 per ton for Bolivian tin; what was the justification for this difference in price; and whether he would initiate early discussions with a view to obtaining a uniform and satisfactory world price for this commodity in view of its importance to the British Colonial Empire. Mr. Creech Jones, in reply, said that the price of tin in Malaya was fixed after consultation with expert opinion on the spot. No price had yet been settled for current supplies of Nigerian tin. In regard to the future of tin prices generally, he was in consultation with the Minister of Supply. According to Mr. Jones's information the figures quoted by Mr. Gammans in respect of other territories were not on a comparable basis with those quoted for Malaya and Nigeria. Mr. Gammans further asked if the Minister would consult with the tin producers, so as to get a price which was in some way related to the conditions, in view of the damage done to the Malayan tin mines, and would the Government see to it that they did not deliberately throw away a valuable source of dollar exchange. Mr. Creech Jones said that matter would be noted in the discussions now going on. Mr. Stokes intervened to ask if the Minister would make clear to the House who fixed these prices? Was it the international tin cartel or his Majesty's Government? Mr. Creech Jones said, obviously these prices were determined by the Government in consultation with expert opinion on the spot.

STEEL RAINWATER GOODS SPECIFIED

The Ministry of Works have informed the Department of Health for Scotland that they cannot agree to the use of cast-iron gutters and rainwater pipes for Swedish timber houses being erected at Falkirk. The Ministry insist on the use of steel gutters and pipes. Falkirk Town Council is protesting to the departments concerned against this decision. The Council claim that the life of steel pipes will be very much less than that of cast-iron pipes, and point out that cast-iron pipes are in any event manufactured locally. The Council are also reminding the Department of Health that when the Swedish timber houses were allocated to the town they agreed that the local manufacture of rainwater goods would be taken into account.

PRICE OF TUNGSTEN ORE REDUCED

The Ministry of Supply announces that the issue price of tungsten ore (other than high-grade scheelite) has been reduced to 75s. per unit of WO_3, delivered consumers' works in the United Kingdom. Allowances for impurities or low WO_3 will continue on the same scales as hitherto. For special high-grade scheelite to the specification of WO_3 minimum 68 per cent., tin maximum 0.60 per cent., arsenic maximum 0.10 per cent., molybdenum maximum 0.10 per cent., the price will continue to be 90s. per unit of WO_3 delivered consumer's works in the United Kingdom.